

Clean Cities International Philippines Trip Report Team Philippines

*Submitted by
ASG Renaissance
March 11, 2005*



Executive Summary

Team Philippines, which includes Lizabeth (Beth) Ardisana, CEO, and Greg Zilberfarb, Vice President of ASG Renaissance along with Bill McGlinchey, a consultant to ASG Renaissance, was in the Philippines from February 19-26 to perform several tasks as part of a multi-agency initiative between USAID, DOE, and PDOE to encourage the use of alternative fuels.

The enthusiastic welcome the Team received at every venue was only matched by the enthusiasm of the members of the Sustainable Energy Development Program (SEDP), who are on the ground in the Philippines and did an excellent job of organizing the week's events.

An order for 200 Compressed Natural Gas (CNG) transit buses has been placed with the initial delivery of 35 buses tentatively scheduled for June 2005. To fuel these CNG buses, two CNG fueling stations are under construction and plan to be open when the buses arrive. The timing of the CNG mechanic training classes and the general overview on CNG fueling was critical to the successful implementation of the buses and the installation of these two fueling facilities.

In addition, Team Philippines participated in the designation of Baguio City as the first Clean Cities in the Philippines during a day-long series of events that included over 200 people attending the Clean Cities kick-off meeting!



Figure 1 - Beth Ardisana facilitates the Baguio City Clean Cities Kick-off Meeting.

Baguio City will begin the program using Coco-Methyl Ester, (CME) Biodiesel. That is Biodiesel produced from coconuts. During our mission we toured the CME production facilities of Chemrez. They sell CME under the brand name BioActiv.

The Philippines are generally considered to be the largest producer of Coconuts in the world. In addition to supplying CME to the Philippines, Chemrez has plans to export CME to Japan.

Overview

This trip report is divided into five sections; Training, Baguio City Clean Cities Kick-off Meeting, Miscellaneous, Next Steps and Survey Results.

Training

The week started off with a day-long seminar at the Philippine National Oil Company, (PNOC) on Monday, February 21. The 75 people in attendance heard presentations from the following speakers on the following topics:

- § Opening Remarks and Introduction, Ms. Rosario Calderon, Senior Technical Advisor Energy and Environment, USAID
- § Overview of the Philippine Alternative Fuels Program, Ms. Teresita Borra, Energy Utilization and Management Bureau, PDOE
- § Overview of ASG Renaissance, Ms. Lizabeth Ardisana, CEO, ASG Renaissance
- § Overview of the Training Classes, Mr. Greg Zilberfarb, Vice President, ASG Renaissance
- § Introduction to NGV Technology, Mr. Bill McGlinchey, Consultant to ASG Renaissance
- § Compressed Natural Gas Fueling Stations, Mr. Greg Zilberfarb
- § Major Fueling Station Components, Mr. Greg Zilberfarb
- § Maintaining a CNG Station, Mr. Greg Zilberfarb



Figure 2 - Participants register for the technical Seminar.

Additionally, during lunch, a Mini-Trade Show was held in the foyer of the PNOC. Seminar participants were able to meet with exhibitors from Cummins-Westport, manufacturers of the CNG engine in most of the transit buses on order and Manila Fluid Systems Components, manufacturers of high pressure fittings used in the assembly of the high pressure fuel lines for CNG.



Figure 3 - Greg Zilberfarb poses with Moy, from Manila Fluid Systems Components, during the Mini-Trade Show.

Because Manila is due to get 200 Compressed Natural Gas (CNG) buses this year, the seminar focused on CNG, although a brief overview of all alternative fuels was included in the day's presentation.

The afternoon session was devoted to CNG fueling and included details on the different types of fueling stations available:

- § Slow-fill
- § Mother-Daughter
- § Fast-fill
- § Buffer
- § Cascade
- § L/CNG

In addition, the major components of a CNG station were identified and discussed in detail:

- § Pad
- § Compressor
- § Storage Vessels and PRD
- § Gas Dryer

- § Priority and Sequential Systems/Valving
- § Dispenser
- § Sizing a Station

The seminar concluded with a presentation focused on maintaining a CNG station.

There is currently one CNG fueling facility located approximately four hours outside of Manila. A planned Mother-Daughter set of CNG fueling stations is planned by Shell.

The Mother station, or the station that will have an underground natural gas pipe line direct feed, will be installed at Malampaya On Shore Gas Plant (MOGP), Tabangao, Batangas. The Daughter station, or the station that will need to have deliveries of natural gas because it will not have an underground gas pipe line feed, will be located in Mamplasan, Laguna.

12•MANILA BULLETIN, Sun., Feb. 20, 2005

US experts on alternative fuels at PNOC seminar Feb. 21-24

Experts on alternative fuels from the United States will conduct a technical seminar on natural gas vehicles at the offices of the Philippine National Oil Co. (PNOC) in Taguig from Feb. 21 to 24 in support of the Department of Energy's (DoE) advocacy to promote the use of alternative fuels in the country.

The DoE has teamed up with the United States Agency for International Development (USAID) and the United States Department of Energy (USDoE), to bring in three experts on alternative fuels under the Sustainable Energy Development Program (SEDP).

A major component of the SEDP is the Philippine Clean Cities Program (PCCP), which aims to improve the quality of air in key cities nationwide by promoting the use of alternative fuel sources like natural gas, biodiesel, liquefied petroleum gas (LPG) or auto gas and fuel ethanol in the transport sector.

It is patterned after the Clean Cities International initiative by the USDoE in major urban centers in the United States and in other countries as well.

William McGlinchey, Greg Zilberfarb and Lizabeth Ardisana will conduct the

technical seminar that will be attended by officials from the energy and transportation sector, the academe, business and members of civil society. They would also provide local dealers a clearer understanding of how compressed gas vehicles operate.

There will also be a two-day hands-on training for personnel who will maintain nearly 70 buses powered by compressed natural gas (CNG). The buses, expected to arrive in June 2005, were bought by local transport companies to replace their existing fleet plying the Manila-Batangas route.

The first day of the seminar will be held at the mini-theatre of PNOC Building 6 at the Energy Center. There will be an orientation on the NGV technology and the basic design and layout of CNG fuelling stations.

A mini-trade show showcasing the latest products offered by CNG suppliers will also be staged.

On the second and third days, the seminar will shift to the Meralco Foundation compound, where participants will be given hands-on training on natural gas vehicles. There will also be actual emissions testing.

Figure 4 - An article that appeared on Sunday in Manila.

On Tuesday, February 22 the training focused on mechanics at the MERALCO Foundation. Bill McGlinchey led over 50 participants in “hands-on” training in addition to lecturing them on Natural Gas Vehicles System Integration and Service.

The MERALCO Foundation was the perfect venue as it offered a state of the art auditorium and a well-equipped maintenance facility where the students rebuilt a CNG regulator.



Figure 5 - Bill McGlinchey lectures at the MERALCO Foundation.

Bill's presentation focused on NGV components and procedures, which included the following topics:

- § Key Terms
- § NGV Fuel Cylinders
- § Manual Shutoff Valve, Regulators and Fuel Lock off
- § Fuel Lines
- § Mixer and Fuel Injection Systems
- § Lab Activities
 - Hands-on Regulator Rebuild
 - Installation of Fuel Lines

Although the class had been limited to 20, Beth and Greg were able to assist Bill in working with over 50 participants, all of whom enjoyed the hands-on training and indicated in a survey we administered, that there was a need for more mechanic training. ([See Survey Results.](#))

On Wednesday, February 23, while Beth and Greg were in Baguio City, Bill continued with a second day of mechanic training at the MERLACO

Foundation. For this session, Bill focused on emissions. Specifically, the topics included:

- § Key Terms
- § Emissions Overview
- § Emissions Testing and Diagnosis
- § Lab Activities
 - Vehicle Emissions Inspection

Bill noted that the class seemed to really grasp the presentation and during the hands-on activities became very proficient at understanding the testing procedures.



Figure 6- Participants are tested on their knowledge of emissions testing procedures.

On Thursday, February 24 we returned to the PNOC building to finish the training. The course was entitled, Vehicle Inspection Methodology and the key topics were:

- § Safety Summary
- § CNG Cylinder Overview
- § Cylinder Types, construction and materials
- § De-fueling Procedures
- § Types and levels of Cylinder Damage
- § Pressure Relief Devices



Figure 7 - Bill discusses the different types of cylinders.

Baguio City Clean Cities Kick-off Meeting

While Bill was lecturing in Manila, Greg and Beth started off Wednesday with a meeting with Mayor Braulio Yaranon of Baguio City. The Mayor was very excited about his city being selected the first Clean Cities and presented Ms. Chingcuanco a key to the city.



Figure 8 - Mayor Yaranon presents a key to the city to Team Philippines.



Figure 9 - Ms. Divina Chingcuanco presents a Clean Cities plaque to Mayor Braulio Yaranon.

After the meeting with the Mayor, a press conference was held announcing Baguio City's selection as the first city in the Philippines to receive the Clean Cities designation.



Figure 10 – Greg, Beth and Ms. Chingcuanco answered reporters' questions during the press conference in Baguio City. (Greg is to the left of the picture.)

SEDP did a great job of announcing our arrival. Ms. Lumen was able to get mention of the Clean Cities Kick-off meeting in several newspapers that ran articles prior to our arrival in Baguio City.

The following articles appeared in the Sunday newspapers in Baguio City.

City hosts launching of clean cities prog

The city has been chosen as pilot area of the Clean Cities Program of the Department of Energy and the US Department of Energy, which will be launched on Feb. 23, during the weekly Kapihan sa Baguio.

The program was developed by the USDOE as it realized the need to reduce dependence on imported fuel oil, as well as turn the effect of global warming and poor air quality around. The program aims to advance and encourage transport groups to use alternative and domestic energy resources. The Philippines' DOE hopes to duplicate successful approaches by designing a Clean Cities Program for the Philippines.

The Clean Air Act was enacted in 1999 to address the growing concerns on the continuous deterioration in the air quality. In support to this, the DOE embarked on an Alternative Fuels and

Technology Program that aims to achieve energy supply security, reliability, and affordability and fuel diversification, while meeting environmental challenges.

USAID, through the Clean Cities International Program, also supports DOE's efforts in developing indigenous, clean and renewable energy supply for the transport sector. A highly visible activity is promoting the use of cocomethyl ester (CME), a bio-diesel fuel blend that not only helps reduce air pollution but also supports the economic development of poverty stricken coconut farmers. USAID will also help implement the Clean Cities roadmap that includes identifying champions, consulting with key stakeholders and sharing information to encourage the local government units (LGUs) and the pri-

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CITY ...

(from page 10)

ate sector in pilot cities to accelerate the use of alternative fuels.

Operating under the guidance of the Clean Cities International, the Philippines' Clean Cities Program brings together all stakeholders driven by the objective of cleaner air for a cleaner environment. Aside from Baguio, other pilot cities include Cavite, Davao, Cebu and Metro Manila.

Present during the launching are Atty. Jose Canivel, Business Development Specialist of USAID; Divina Chingcuanco, Country Director of the Sustainable Energy Development Program (SEDP) of USAID, USDOE and DOE; Elizabeth Ardisana, also of SEDP; and outgoing

Energy Secretary Vincent Perez.

Coinciding with the launching of the Clean Cities Program is the launching of the Clean Cities Baguio Coalition. — PIA-CAR

Clean cities 02-20-05 TBR program to be launched in Baguio

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February 20, 2005

ZigZag Weekly

Baguio chosen to pilot clean cities program of DoE

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High Plains Journal 20 Feb. 2005

DoE chooses Baguio as pilot area

481/17-20-05

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Baguio gets US backing in anti-air pollution drive

BY HARLEY PALANGCHAO
Northern Luzon Bureau

BAGUIO CITY: The city has been given another weapon to stave off a looming health crisis with the United States' decision to designate the city as among the pilot areas for the clean cities program.

Divina Chingcuanco, country director of the US-funded Sustainable Energy Development Program, told reporters on Wednesday that Baguio has been chosen as pilot area on the promotion of alternative fuels like compressed natural gas (CNG), coco diesel and other types of biodiesel and fuel ethanol.

Chingcuanco said the city could help the national government save funds allotted yearly to treat diseases caused by poor air quality besides helping the Clean Air Act campaign of the government.

The study showed that the government has been spending almost US\$400 million, or almost P20 billion, annually to treat illnesses ranging from respiratory infections to cancer, caused by the degenerating quality of air.

Besides Baguio, the project will also be carried out in Metro Manila, Cebu and Davao.

The program has already been proven successful in Dhaka, Bangladesh, which encountered 3,580 premature deaths from mid to late 1990s.

Lizabeth Ardisana said that while they could not yet quantify how much from the public-health budget the city and the national government could save from adopting the program, she said that the other 80 cities worldwide that adopted the program noted an improvement in their air quality and de-



■ Divina Chingcuanco, country director of the US-backed Sustainable Energy Development Program, explains to Baguio officials, led by Mayor Braulio Yaranon, the merits of adopting the program, saying it would be a big help in the drive for clean air and environment of key cities in the country.

PHOTO BY HARLEY PALANGCHAO

crease in cases of respiratory diseases.

In Baguio, Vic Aquitana, the project development officer, reported that government vehicles detailed with the City Engineers Office and CEPMO have

been using coco diesel for the past year.

The problem, however, is that the lone gasoline station offering coco diesel is on Ambuklao Road in Benguet province.

Tenebrancia said he would study if the city council could enact an ordinance mandating local gasoline stations in Baguio to include coco diesel fuel among the list of their services.

Figure 11 - This article appeared in the local paper on Thursday, after our press conference.

During the kick-off meeting the following presentations were given:

- § Overview of PDOE Alternative Fuels Program, Ms. Chingcuanco
- § Overview of ASG Renaissance, Ms. Beth Ardisana
- § Overview of Biodiesel/Biofuels, Mr. Greg Zilberfarb
- § Clean Cities Roadmap, Ms. Beth Ardisana

Following the presentation, Beth facilitated an election to determine the new Coordinators. The two Coordinators are:

- § The Oversight coordinator is Councilor Erdolfo V. Balajadia. Mr. Balajadia will have responsibility of the entire Clean Cities ensuring the overall program goals are met, as well as interfacing with government officials.
- § The Working Coordinator is Mr. Perfecto F. Itliong, Jr. who will handle the day-to-day duties of getting things done.

Then, we formed Committees in the following areas:

- § Monitoring
- § Technical
- § Training/Marketing
- § Infrastructure

Follow up meetings were proposed within 2-4 weeks to organize the committees and to determine short and long-term goals. The focus of the Clean Cities effort will be to support the increased use of CME. The short-term goal is to increase the availability of CME in Baguio City. While the long-term goal is to provide pre-mixed B1 at local fueling facilities.

Miscellaneous

Thursday afternoon, Beth and Greg visited the site of the proposed CNG Daughter station located about 35km from Manila on an existing Shell site. The construction work had started and the site is to be ready by June 2005, just in time for the delivery of the first 35 CNG transit buses.

The facility offers ample space for fueling the CNG transit buses and will use a system from Argentina based Galileo. (We will discuss this in detail in our accompanying paper.)



Figure 12 - Site of future Shell CNG Daughter station.



Figure 13 - Team Philippines poses with Mr. Lao, the owner and operator of Chemrez.

On our last day, Friday, February 25, Team Philippines visited with Chemrez and toured the CME production facilities. Chemrez is the largest producer of CME in the world and has plans to export CME to Japan. CME is distributed in a B1 blend, where 1 percent CME is mixed with 99 percent diesel.

Due to the cleansing affect of CME, even in low blends such as B1, the results in diesel engines in the Philippines have been remarkable! Fuel savings of 17 percent have been reported as well as reduced emissions.

Next Steps

Training

At our debriefing meeting with Ms. Chingcuanco and Ms. Calderon, it was agreed that there was a need for additional training, training that could be self-sustaining, perhaps through an organization like the MERALCO Foundation or TESDA. This need is echoed in our surveys that were conducted after each class and our summarized in the following pages.

The training conducted was a great initial step of a long-term process. The CNG Fueling Station classes were designed for a general audience and provided a great overview for all in attendance. The next step is to provide detailed, station specific training. For example, since the first two CNG stations will be purchased from Galileo, specific training on Galileo equipment should be provided. (We will discuss CNG Fueling Station recommendations in a accompanying paper.)

The purpose of the mechanic-based training was to provide an entry level training class to mechanics. The audience, made up of mechanics, engineers, regulatory officials and others, was well suited for this entry-level class. The next step is to provide mechanic specific classes aimed at the CNG systems manufactured by the three bus manufacturers that will be supplying the initial order of 200 CNG buses later this year.

Our goal is to create a pool of technicians, fleet operators and fuel providers that can train and certify others. Based on the results from our surveys, we have identified the following training needs that we have broken down into short and long-term needs.

Short-term Needs

ASG Renaissance has identified an immediate need for the following actions:

- § Work with Shell to ensure the two planned CNG fueling stations will adequately meet the demand of the 200 CNG buses
- § Develop, in conjunction with CNG Engine Manufacturers, a CNG Mechanics Class to train the mechanics that will be maintaining the 200 CNG buses
- § Develop a CNG cylinder Inspection Class
- § Work with Officials to develop a governing agency to monitor and inspect CNG vehicles

Long-term Needs

CNG Fueling Station Training

Working with CNG fueling station suppliers, ASG Renaissance will develop training classes designed for trainers.

Here are a few of the long-term topics we would like to cover:

- § Details on station specifications
- § Cost estimating
- § Safety issues
- § Dispensers
- § Codes and standards as related to fueling
- § Station economics.

CNG Mechanic Training

As mentioned above, our short-term needs are to work with the mechanics that will be servicing the initial order of 200 CNG buses. Our long-term needs continue with transit, but need to focus on other vehicle types as identified. For example, if there is a push for conversion of existing vehicles like Jeepneys or sedans.

Here are a few of the long-term training topics:

- § CNG conversion techniques
- § CNG Fuel system layout, sizing and design
- § Detailed discussion of the CNG conversion process
- § More “hands on” classes
- § Codes and standards as related to fueling

In addition to the detailed classes above, it is our belief that additional general overview classes similar to the training we provided during this mission are needed in every city identified as another Clean Cities.

This training would create interest for the private entrepreneur, a necessary ingredient in the Clean Cities model of success! Additionally, these general overviews inform key stakeholders like Shell Oil and the various bus manufacturers, as well as government officials and make the transition to alternative fuels easier.

Clean Cities

The Baguio City Clean Cities is off to an excellent start. There are a number of next steps required to be designated as part of the Clean Cities International Program. An overview of these steps include:

- § Formalize committees, schedule meetings
- § Set short and long-term program objectives
- § Create a timeline for program objectives
- § Verify the effectiveness of CME at appropriate mixture levels
- § Prepare a Program Plan identifying stakeholders and commitments
- § Complete a Memorandum of Understanding (MOU) with all stakeholders
- § Submit Program Plan for designation as a Clean Cities International to USDOE

As the Baguio City Clean Cities International Program begins, plans need to be developed to expand the program to other cities in the Philippines.

ASG Renaissance is prepared to provide assistance to the Clean Cities efforts in Baguio City and the other designated cities as required to achieve designation.

Survey Results

At the end of each day the class participants were asked to rate the quality of the instruction (see Appendix A). The evaluation consisted of twelve subjective questions and eight open-ended questions. The quantitative data was obtained using a scale where: 'Excellent'=5, 'Very Good'=4, 'Good'=3, 'Fair'=2, and 'Poor'=1. Further, within the survey, the questions were divided into ratings of the instructor (Questions 1-6), the training material (Questions 7-8), the time allotment (Question 9-10) and an overall rating of the training (Questions 11-12).

On two of the four days an additional pre and post-test was administered to obtain a quantitative measure of the training effectiveness (samples of the tests are included as Appendix B and C). These scores were compared and the net increase (or decrease) was tabulated for each participant.

The combined statistics for the four classes are summarized in the following table.

Average change in pre and post-test scores	57.9% increase!
Average rating of the instruction	4.52* Excellent
Average rating of the training material	4.30 Very Good
Time allotted to classroom and hands-on activity	4.24 Very Good
Overall rating of the course	4.44 Very Good

Figure 14 -5=Excellent; 4=Very Good; 3=Good; 2=Fair; 1=Poor

**In that there were three different instructors, this is a significant endorsement of the ASG Renaissance staff.*

Finally, SEDP conducted an independent evaluation on Day 4 (see Appendix D) and the results were similar. Overall rating of the SEDP survey was 4.5 (excellent) on a similar scale.

Conclusions

The overwhelming majority of the participants found the information presented was interesting, attention holding and current (Question 14 and 15). They also felt the length of each class was appropriate. Again, in answer to the question of whether the training met their expectations (Question 17), eighty seven percent responded affirmatively.

Question 16 asked if there were additional topics they would have liked to discuss. This gives valuable insights regarding future training needs. Specifically, there were reoccurring requests for more details on fill station specifications, i.e., cost estimating, safety issues, qualification of dispensers, codes and standards and economics.

Audiences at MERALCO wanted more information on conversion techniques, fuel systems layout, sizing and design and detailed discussions on the conversion process. There seems to be interest in not only gasoline conversions but also diesel conversion opportunities.

Question 18 is best summarized by reading the individual comments. There was a consensus that the 'hands-on' lab activities were one of the best aspects of the training. Several perceptive comments dealt with the Philippine support of alternative fuels and their impact on the environment and global warming.

Lastly, Question 19 asked if you would recommend this training to others and we were impressed with the results. Ninety eight percent said, "Yes!"

The open-ended questions are presented without editing or comment:

PNOC Day 1 Introduction to CNG Systems and Fill Stations

14. The materials/information presented in this course were:

- a. interesting/ attention-holding
- b. up-to-date (current)

a. Yes-50	No-1
b. Yes-45	No-1

15. How would you rate the length of this course, as far as having enough time to provide you with a general overview of CNG fueling stations?

too long-5 too short-6 about right-38

16. Are there any specific topics that were not covered in this course that you would have liked to discuss?

Yes-15	No-30
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If yes, what are those topics?

Some cost estimates on CNG stations

Safety issues, thorough discussion on standards and codes, layouts

Factors that cause emissions i.e., exposed to what chemicals/basic compounds

Feasibility study of first costs

More Knowledge

NGV type 1 & NGV type 2

Update on status, a complete reference for CNG

CNG production system & cylinder safety system

Safety distances & safety devices, i.e., shut-off valve, installed at the stations

CNG Stations

- Cost range for various equipment, percent volume of CNG use per month/day
- New update modules on gas compressors
- Data on conversions/operating/maintaining a CNG filling station
- More time to digest
- Economics of CNG gas claim i.e., tariff
- Maintaining CNG vehicles discussion from the point of view of the vehicle owner
- More focus on operation of NGV
- Efficiency of CNG engine compared to diesel/gasoline engines; their consumption
- Rate/liter per KM

17. Did this course meet your expectations based on the information/materials you received before starting the class?

Yes-37

No-6

18. What was the Best Aspect of your experience during this class?

- NGV station components
- Great visual aids
- Knowledge of station of CNG
- Additional knowledge of CNG
- Provided the reference guide for the integration of natural gas systems
- New knowledge about the usage of CNG
- Presentation of animated drawing to explain process
- Fueling aspect
- To know how NG operates
- Understanding the basic CNG-NGV systems
- Completeness of info
- Exciting
- Information regarding the use of refueling stations
- Maintaining of CNG station, major fueling components
- Presentation/interaction with stakeholders
- Increased my knowledge to CNG
- Sizing for CNG stations
- Quality discussion/presentation
- Knowledge of hoe CNG/NGV systems could enhance the future of our environment
- Knowing how CNG systems operates/refilling station design
- Interaction with speaker
- The sensitivity of the organizers & speakers to the needs of the audience and their quick response to needs and questions
- Speaker interaction/animated visual aids
- Seeing how things work through simulations
- Speaker demonstrates knowledge in topics discussed/nice slides

Understanding the refueling process
Fuel Station
Fuel systems/safety issues
Fuel station components

19. Would you recommend this course to others?
Yes-48 No-1
-

MERALCO Day 1 NGV Components and Procedures

Comments from Exit Survey

14. The materials/information presented in this course were:
a. interesting/ attention-holding
b. up-to-date (current)
a. Yes-23 No-1
b. Yes-23 No-0

15. How would you rate the length of this course, as far as having enough time to provide you with a general overview of NGV components?
too long-0 too short-6 about right-13

16. Are there any specific topics that were not covered in this course that you would have liked to discuss?
Yes-7 No-16

If yes, what are those topics?
Qualification and calibration of dispenser
Conversion techniques
Design considerations for NGV conversions
Fuel systems layout, technical sizing & design
Experience on conversion of vehicles to natural gas
About engines
Detailed discussion on the conversion

17. Did this course meet your expectations based on the information/materials you received before starting the class?
Yes-21 No-2

18. What was the Best Aspect of your experience during this class?
Getting first hand knowledge of NGV
Discussion and shop
Learn by doing

Hands on activity

Hands on

Hands on, brainstorming

Assembling and reassembly of regulator

Practical tips based on instructors' experience, that you don't find in textbooks

Principles and operation of CNG

Hands on

Lab exercise

Hands on

Disassembly and reassembly of regulator

Dismounting of regulator

Adoption of CNG as a National Transportation Fuel

Knowing procedures and components of NG vehicles

Hand on activities and seeing what's inside

19. Would you recommend this course to others?

Yes-26

No-0

MERALCO Day 2 NGV Components and Procedures (con't.) and Emissions

14. The materials/information presented in this course were:

a. interesting/ attention-holding

b. up-to-date (current)

a. Yes-46 No-0

b. Yes-38 No-0

15. How would you rate the length of this course, as far as having enough time to provide you with a general overview of NGV components and emissions?

too long-3 too short-9 about right-33

16. Are there any specific topics that were not covered in this course that you would have liked to discuss?

Yes-21

No-21

If yes, what are those topics?

Comparison of Diesel & CNG fuel

Timing

Base timing of Alternative gas vehicle

No exact ideas, technology is new

Laboratory

Fuel tank capabilities, fuel consumption

Timing

Conversion exercise

Engine operations

- Conversion of a diesel to NGV
- NG proportioning device selector for diff. Volume displacement
- Compare with local emissions standards
- Actual conversion of diesel engines
- NGV conversion technology
- Preventative Maintenance
- About CNG & NGV

17. Did this course meet your expectations based on the information/materials you received before starting the class?

Yes-37 No-6

18. What was the Best Aspect of your experience during this class?

- Hands On
- Lab work and testing
- Lab activities
- Theory and actual
- Carbon Monoxide
- Clear Explanation of Air-Fuel ratio effect on emissions
- More chemistry, knowledge on exhaust gas
- Having both theory and practical
- Very important to global warming, affects the whole world
- Hands on
- Hands on
- Disassembly of parts
- Knowing the cause of high exhaust emissions
- Additional knowledge
- Hands on
- Hands on very comprehensive based on actual experience of instructor
- Very Informative
- Emissions, how they occur

19. Would you recommend this course to others?

Yes-41 No-1

The total sample size was 126 respondents.

APPENDIX A - EXIT SURVEY

COMPRESSED NATURAL GAS FUELING STATIONS

Location: PNOC

Instructor: Mr. Greg Zilberfarb, ASG Renaissance

DIRECTIONS: Please circle the appropriate response using the following rating scale: 5=Excellent; 4=Very Good; 3=Good; 2=Fair; 1=Poor

- | | | | | | |
|-------------------------------------------------------------------------------------------------------------|----|---|---|---|---|
| 1. The instructors' preparation for this course | 5 | 4 | 3 | 2 | 1 |
| 2. The instructor's knowledge of this course's subject matter | 5 | 4 | 3 | 2 | 1 |
| 3. The instructor's ability in presenting the materials | 5 | 4 | 3 | 2 | 1 |
| 4. The instructor's ability in answering questions | 5 | 4 | 3 | 2 | 1 |
| 5. The instructor's interaction with participants (encouraged to participate) | 5 | 4 | 3 | 2 | 1 |
| 6. Overall quality of the instructor's presentation | 5 | 4 | 3 | 2 | 1 |
| 7. The contribution of the material (manual, handouts) to your understanding of the course's subject matter | 5 | 4 | 3 | 2 | 1 |
| 8. The quality and usefulness of the visual aids (videos, overhead transparencies, slides, etc.) | 5. | 4 | 3 | 2 | 1 |
| 9. The time allotted to presentations and discussions | 5 | 4 | 3 | 2 | 1 |
| 10. The contribution of this course in increasing your knowledge | 5 | 4 | 3 | 2 | 1 |
| 11. The overall quality of this course | 5 | 4 | 3 | 2 | 1 |

DIRECTIONS: Answer the following question by checking the appropriate response and, where requested, writing your comments in the spaces provided.

14. The materials/information presented in this course were:

A. interesting/ attention-holding _____ Yes _____ No

B. Up-to-date (current) _____ Yes _____ No

15. How would you rate the length of this course, as far as having enough time to provide you with a general overview of compressed natural gas fueling stations?

_____ too long _____ too short _____ about right

16. Are there any specific topics that were not covered in this course that you would have liked to discuss? _____ Yes _____ No

If Yes, what are those topics? _____

17. Did this course meet your expectations based on the information/materials you received before starting the class? _____ Yes _____ No

18. What was the **BEST ASPECT** of your experience during this class?

19. Would you recommend this course to others? _____ Yes _____ No

20. What changes, if any would you recommend to improve the overall quality of this course? Please be specific.

21. How did you or your company find out about this class? _____

**THANK YOU FOR ATTENDING THIS COURSE
AND RETURNING THIS EVALUATION FORM**

END OF EVALUATION

APPENDIX B PRE TEST SHEET
NGV Components and Procedures

NAME: _____

1. The two primary market drivers for natural gas as a transportation fuel are:
 - a. economics and environment
 - b. energy independence and economics
 - c. emissions and environment
 - d. reduced emissions and energy independence
2. Natural gas is composed primarily of
 - a. methane
 - b. propane
 - c. ethane
 - d. pentane
3. What country has the largest number of natural gas vehicles (NGV's)?
 - a. U.S.A
 - b. Venezuela
 - c. Argentina
 - d. India
4. Natural gas is _____ than/as air.
 - a. heavier
 - b. lighter
 - c. about the same
 - d. is the same
5. The ignition point of natural gas is _____.
 - a. higher than gasoline
 - b. lower than gasoline
 - c. about the same as gasoline
 - d. is the same as propane
6. Typical storage pressures for natural gas cylinders is
 - a. 2400 psi (160 bar)
 - b. 3000 psi (200 bar)
 - c. 3600 psi (240 bar)
 - d. All the above.
7. The octane rating of natural gas is
 - a. 110-130
 - b. 87-93
 - c. 95-104
 - d. 90-95
8. A typical safety factor for CNG cylinders is
 - a. 4 times the working pressure
 - b. 2.25 to 2.5 times the working pressure
 - c. 1.4 times the working pressure
 - d. the same as the working pressure

9. Natural gas vehicle emissions are
 - a. Can be higher than gasoline or diesel
 - b. Can be lower than gasoline or diesel
 - c. Always better than gasoline or diesel
 - d. Both A and B
10. One advantage of a bi-fuel NGV is
 - a. Greater range
 - b. More power
 - c. Better air-conditioning
 - d. All of the above
11. PRD stands for:
 - a. Proportional relief device
 - b. Pressure relief device
 - c. Pressure retard device
 - d. Protection Rescue and Delivery
12. PRD's may not release gas into the
 - a. passenger compartment
 - b. engine compartment
 - c. wheel well
 - d. all the above
13. The proposed international standard for NGV fill connectors is similar to
 - a. New Zealand probe (NZ-1)
 - b. NGV-1
 - c. NGV-2
 - d. NGV-3
14. Technician A says that an automatic shutoff valve can be used to turn off the gas supply of a CNG vehicle when the engine is not running. Technician B says that a manual shutoff valve is used to shut the flow of gas when a CNHG vehicle is being serviced. Who is correct?
 - a. Technician A
 - b. Technician B
 - c. Both A and B
 - d. Neither A or B
15. When should a CNG vehicle's fuel system pressure be relieved (vented)?
 - a. during refueling
 - b. once a week
 - c. every 30 days
 - d. before maintenance or service

NGV Components, Procedures and Emissions

1. The ideal gasoline to air ratio (by wgt.) is _____. The ideal natural gas A/F ratio is _____.
 - a. 14.7:1, 17.2:1
 - b. 14.7:1, 15.5:1
 - c. 15.5:1, 14.7:1
 - d. 13.5:1, 14.7:1
2. A poor ignition system can cause which of the following?
 - a. Misfiring
 - b. Hard starting
 - c. Reduced fuel economy
 - d. All of these
3. Referring to the natural gas and gasoline advance curves, base timing for natural gas would be expected to be _____.
 - a. Greater than gasoline base timing
 - b. The same as gasoline base timing
 - c. Lower than gasoline base timing
 - d. Always set to 0 degrees BTDC
4. This exhaust gas is a good indicator of how rich or lean the air/fuel mixture is:
 - a. λ Lambda
 - b. NO_x
 - c. HC
 - d. CO₂
5. This gas could be an indicator of ignition or mechanical problems:
 - a. CO
 - b. NO_x
 - c. HC
 - d. O₂
6. This gas is formed under high temperature:
 - a. CO
 - b. NO_x
 - c. HC
 - d. O₂
7. What might cause a 3% to 8% CO emission?
 - a. Leaking injectors
 - b. Dirty air cleaner
 - c. High pressure regulator setting incorrect
 - d. All of these
8. Natural gas vehicle emissions are

Team Philippines Trip Report

- a. Can be higher than gasoline or diesel
 - b. Can be lower than gasoline or diesel
 - c. Always better than gasoline or diesel
 - d. Both A and B
9. Welded stainless steel tubing will
- a. Have a higher burst strength than seamless stainless tubing
 - b. Have a lower burst strength than seamless stainless tubing
 - c. Have the same burst strength as seamless stainless tubing
 - d. Result in better air conditioning